III SELECTING SITE DESIGN, SOURCE CONTROL AND STORMWATER TREATMENT BMPS

III.1 INTRODUCTION

New and redevelopment projects can comply with the NPDES Permit Provision C.3 to reduce the adverse impacts of stormwater pollutants and increases in peak runoff rate by implementing a variety of stormwater BMPs (Best Management Practices, see Glossary for definition). The purpose of this Chapter is threefold:

The goal of this Chapter is to provide information on selecting appropriate permanent site design, source control, and stormwater treatment Best Management Practices (BMPs) for new and redevelopment projects.

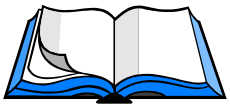
a) Define the various site design, pollutant source control and stormwater treatment[1] BMPs, present the factors that impact their performance and compare their relative success at treating different constituents;

b) Describe the permit requirements for BMP use; and,

c) Provide guidance on selecting BMPs best suited for a specific project

Model conditions of approval, BMP selection matrices and other guidance are provided to assist municipal staff and project proponents in choosing the most appropriate site design, source control and/or stormwater treatment BMPs for new and redevelopment projects. Pesticide reduction and vector control issues are also discussed in this Chapter.

The BMPs are organized under the categories of site design, source control, and stormwater treatment BMPs. For the purposes of this Handbook, the following general definitions apply.



Definitions →

- **Site Design Measures**: Site planning approaches aimed at either preventing or reducing adverse impacts of stormwater pollutants and increases in peak runoff rate, volume, and duration on water quality and beneficial uses. Site design measures use techniques such as protection of natural resources and/or reduction of impervious surfaces when planning the layout of a development or redevelopment project.

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- **Source Control Measures**: Structural controls or operational practices designed to prevent or limit pollution generation from a source (e.g., chemical storage area, industrial processing, vehicle washing and/or

[1] The NPDES permit uses the terms stormwater treatment BMP and pollutant removal treatment system interchangeably.

maintenance area, etc.) so that pollutants do not contact stormwater. In this Handbook, source control refers to controlling sources of pollutants, not sources of flow (hydrologic source control). Hydrologic source control is covered under site design measures.

- **Stormwater Treatment BMPs**: Landscape or structural systems designed to treat or remove pollutants in stormwater or to reduce the amount or rate of stormwater. Treatment controls include detention basins, water quality wetlands, vegetated swales, bioretention, filters, and solid separators.

← *Definitions*

III.2 SITE DESIGN MEASURES

Definition and Purpose

Site design measures for water quality protection integrate basic stormwater management and hydrological concepts into site planning to create development projects that mitigate their impact on stormwater quality. The five (5) main site design principles that promote water quality protection include[2]:

(a) Define and locate the development envelope in order to protect sensitive areas and minimize changes to the natural topography;

(b) Minimize impervious surface areas;

(c) Maximize permeability by preserving open space and using permeable pavement surfaces where feasible;

(d) Maximize the choices for mobility by planning for alternative modes of transportation other than automobiles; and,

(e) Use drainage as a design element.

Tools To Promote Incorporation of Site Design Measures

Standard Conditions of Approval. A compilation of model standard conditions of approval for site design measures, together with source control and treatment control conditions of approval can be found in Attachment III-1. Although defined as conditions of approval, Co-permittees can adapt and use these in various ways, including as mitigation principles, in 60-day letters, or as initial guidelines. (Some Co-Permittees have included source control BMPs in their municipal codes. In such cases, the Model Conditions of Approval have been replaced by Co-permittees own documents).

Selection Matrix. Project proponents and municipal staff can use the selection matrix found in Attachment III-2 to help narrow the menu of potential site designs and other controls for their specific site characteristics.

Regional and Statewide Resources. Program staff together with the Santa Clara Basin Watershed Management Initiative's Land Use Subgroup developed a number of model site design development principles (Appendix C) for protecting

[2] For further details, see Chapter 4 of BASMAA's *Start at the Source* (1999), available electronically at www.scvurppp.org.

watershed health in the Santa Clara Basin. These principles provide ideas for those wishing to have more detailed guidelines for water quality and beneficial use protection. With slight modifications, the language can be reworked to form specific goals, policies, implementation measures and/or other guidance as useful and appropriate.

Co-permittees and project proponents are also highly encouraged to use the Bay Area Stormwater Management Agencies Association's (BASMAA's) "*Start at the Source"* (1999) and the California BMP Handbooks as good overviews of better site design concepts. The Selection Matrix in Attachment III-2 also references specific pages from BASMAA *Start at the Source* (1999) and the California BMP Handbooks. They can be accessed electronically at www.scurppp.org and www.cabmphandbooks.com, respectively.

BASMAA's *Start at the Source Tools* handbook (2000) is useful resource for municipalities looking for example language to use when updating their General Plans and other development policies. Each Co-permittee has received a copy of this handbook. For additional copies contact the Program at (408)-720-8811.

Optimize Site Designs to Help Meet C.3 Requirements and Minimize Treatment System BMPs

Applicants can minimize the size of required treatment system BMPs by optimizing their site design to reduce the amount of impervious surface area through using the following techniques:

- **Cluster buildings** on portions of the site to reduce the need for impervious driveways and walkways and to protect natural areas;
- **Reduce the building footprint** by creating multistory buildings or locating portions of the building underground; and,
- **Minimize pavement** by minimizing street and driveway widths in low-traffic volume residential areas.

III.3 SOURCE CONTROL MEASURES

Definition and Purpose

Source control measures are post-development BMPs that prevent pollutant generation, discharge and runoff by controlling it at its source or, at a minimum, limiting pollutant exposure to stormwater. Typically, a source control measure involves a cover, berm, drain connection to the sanitary sewer system or some other structural design element that prevents a pollutant from becoming a direct discharge to stormwater. Source control measures can also include operational BMPs, such as routine pavement sweeping, using a wet vactor to collect soapy washwater, or instituting a practice to immediately safely drain fluids from leaking vehicles. Both structural and operational source control BMPs can prevent pollutants from entering stormwater runoff.

Additional Site Design Resources

The following resources are available to assist project designers to optimize site designs:

- BASMAA, *Using Site Design Techniques to Meet Development Standards for Stormwater Quality* (May 2003), illustrates how various site planning concepts such as those found in the BASMAA Start at the Source manual can be used to help minimize the treatment requirements of Provision C.3. Both are available for download at www.scvurppp.org.
- SCVURPPP, *Developments Protecting Water Quality – A Guidebook of Site Design Examples.* In April 2004, the Program completed a guidebook illustrating numerous examples of developments located throughout Santa Clara Valley that have incorporated water-quality friendly site designs. This guidebook is designed to be used by both Co-permittees and project proponents to generate ideas for new projects and to recognize the opportunities for using site design techniques and certain source controls to minimize the impacts of development on water quality. The guidebook will be available on the SCVURPPP website at www.scvurppp.org by July 2004.
- SCVURPP, "Summary of Fall 2003 SCVURPP/SCBWMI LUS Site Design Dialogue Results." This table summarizes underlying potential conflicts to implementing site design BMPs and provides suggestions on potential solutions to such hurdles. The table may be found in Appendix C and will be available on the SCVURPPP website at www.scvurppp.org by July 2004.

Model Source Control Measures

Source control measures can be imposed as either up-front submittal or checklist requirements, conditions of approval, CEQA mitigation measures or plan check comments, and so on depending on the particular planning process used by the municipality.

As described under the Standard Conditions of Approval, a model list of source control measures was developed by the Program and can be found in Attachment III-1, *Model Conditions of Approval for Meeting C.3 Requirements*. The list arranges source control measures by their associated pollutant source, (e.g., refuse areas, parking lots, and vehicle/equipment cleaning). Under each pollutant source, several source control alternatives are given. For example, the following structural BMPs are given for refuse areas: 1) enclosed and covered areas for dumpsters and recycling containers, and 2) drains beneath dumpsters shall be connected to a grease interceptor prior to discharging to the sanitary sewer. Co-permittees are encouraged to use the list as a menu, selecting appropriate measures to apply to specific projects. Project proponents are encouraged to use the list proactively, as guidelines. As long as the intent of the measure is preserved, Co-permittees do not have to use the exact wording of the model source control measure.

III.4 STORMWATER TREATMENT BMPs

Definition and Purpose

Stormwater treatment BMPs are structural or landscaped facilities that remove pollutants from stormwater. Stormwater treatments BMPs are required for non-exempt Group 1 and Group 2 (after April 15, 2005) projects. The major types of treatment facilities are bio-retention, vegetated swales, filters, detention basins (dry ponds) water quality wetlands, and solid separators. Permit Provision C.3 (and thus this Handbook) focus on permanent, post-construction treatment systems rather than those treatment controls placed temporarily during the construction process (e.g., temporary detention basins and other treatment measures designed to remove sediment from stormwater at construction grading sites).

Definitions →

Volume-based Versus Flow-based BMPs. The two (2) basic treatment removal techniques are volume-based and flow-based BMPs. Volume-based BMPs detain stormwater for a certain period and treat primarily through settling and infiltration. Flow-based BMPs treat pollutants from a moving stream of water through filtration, infiltration, and/or biological processes. The selection matrix in Attachment III-2 indicates whether specific BMPs are volume-based, flow-based or a combination of the two. The type of control is important for determining the method to be used to size the BMP (see Chapter IV for more information on the hydraulic sizing of treatment controls). Specific definitions for several treatment BMPs are provided in Table III.1, below.

Selecting Stormwater Treatment BMPs.

In general, the goal for meeting stormwater requirements on a development site is to reduce urban runoff pollution from new development and redevelopment as much as possible through site design and source control measures in order to reduce the amount of runoff needing treatment. This approach minimizes but does not necessarily eliminate the need to implement stormwater treatment BMPs. In essence, implementation of stormwater treatment BMPs is a last line of defense that has negative attributes such as their expense, the use of "developable" space on an applicant's project, and the need for adequate maintenance over the life of the project to remain effective. (See Chapter VI for detailed information about long-term maintenance requirements.)

If, after applying site design and source control measures described in previous subsections, a proposed project exceeds the minimum threshold of one (1) acre (43,560 square feet) or eventually the Group 2 minimum threshold of 10,000 s.f.[3] of impervious area, a project applicant will need to select the most appropriate treatment measure(s) for effectively removing pollutants. The decision to select a particular stormwater treatment BMP and a municipality's review of the proposed selection should be based on the following factors:

- Land use activity;

[3] Co-permittees may propose an alternative Group 2 minimum threshold. See your Management Committee representative for updates.

- Expected pollutants of concern;
- BMPs effective at removing those pollutants and for source control;
- Site constraints (drainage area, slope, soils, topography, etc.);
- Capital cost; and,
- Ease of maintenance and maintenance cost.

Additional factors that impact the selection of a specific type of stormwater treatment BMP are vector concerns and groundwater quality concerns related to infiltration devices. These additional factors are closely related to design issues described in the next Chapter (Chapter IV) and operation and maintenance issues described in Chapter VI.

Table III.1

Stormwater Treatment Controls/Best Management Practice (BMP) Descriptions and Categories for Infiltration Measure Guidelines

Stormwater Treatment BMP[1]	Definition[2]
Category A: BMPs defined as Infiltration Devices.[3]	
Dry well	Structure placed in an excavation or boring, or excavation filled with open-graded rock, that is designed to collect stormwater and infiltrate into the subsurface soil.
Infiltration basin	Shallow impoundment that is designed to infiltrate stormwater into the subsurface soil.
Infiltration and exfiltration trench	Long narrow trench filled with permeable material (e.g., gravel), which may contain perforated pipe (exfiltration), designed to store runoff and infiltrate through the bottom and sides into the subsurface soil. Includes french drain.
Unlined Retention Basin	A basin without an outlet that is designed for storing runoff and infiltrating stormwater into the subsurface soils. Basin is not designed to drain runoff into any stormwater conveyance system.
Unlined or open-bottomed vault or box below grade	Below grade structure designed to receive runoff from conveyance systems and store stormwater. Storage structure allows infiltration of stormwater into subsurface soil. Includes bubble ups and permeable pavement with underground storage.
Category B: BMPs not defined as Infiltration Devices because they treat stormwater prior to infiltration into the subsurface. This category includes all landscape measures that utilize infiltration through surface soils.	
Bioretention	System designed to filter pollutants from runoff using a combination of vegetated buffer strip, sand bed, ponding area, organic layer, planting soil and plants.
Constructed wetland	Constructed detention basins that have a permanent pool of water throughout the year and capacity for temporary additional storage of runoff that is released via an outlet structure. They differ from wet ponds in that they are typically shallower and have greater vegetation coverage.
Lined retention pond/irrigation system	System designed to capture runoff in a holding pond with impervious bottom and subsequently use the captured volume for irrigation of landscape with natural pervious areas.
Permeable pavement	Permeable hardscape or paved surface that allows surface runoff to infiltrate into surface soil (e.g., turf block, brick, natural stone, cobbles, gravel, etc.).

Table III.1 (Continued)

Stormwater Treatment Controls/Best Management Practice (BMP) Descriptions and Categories for Infiltration Measure Guidelines

Stormwater Treatment BMP	Definition
Vegetated filter or buffer strip	Linear strips of vegetated surfaces that are designed to treat sheet runoff flow from adjacent surfaces.
Vegetated swale Bio swale	Open, shallow channels with vegetation covering side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points.
Wet pond	Constructed detention basins that have a permanent pool of water throughout the year and capacity for temporary additional storage of runoff that is released via an outlet structure. They differ from constructed wetlands in that they typically have a greater average depth and less vegetation.
Category C: BMPs that discharge treated stormwater directly to the storm drain system.	
Devices w/ impermeable liner and underdrain/ outfall to storm drain	Structures that transport or store stormwater (e.g., lined drainage sumps, catch basins, conveyance systems) and discharge to the stormwater conveyance system, with an impervious bottom or liner that prevents infiltration into subsurface soil.
Extended detention basin	Constructed basins with drainage outlets that are designed to detain runoff from a water quality design storm for some minimum time (e.g., 72 hours) to allow settling of sediment and pollutants.
Hydrodynamic Separator	Flow-through structures with a settling or separation unit that removes sediments and other pollutants.
Media filtration device	Two-chambered systems that include a pretreatment settling basin and a filter bed filled with sand or other absorptive filtering media.
Planter Box, Contained or Flow-Through	Structures that are built on either impervious (contained) or pervious surfaces (flow-through) designed to intercept rainfall and slowly drain it through filter media and out of planter.
Green Roof Roof garden	Vegetated roof systems that retain and filter stormwater prior to drainage off building rooftops.
Underground Detention System, Wet Vault	System that consists of underground detention tank, vault or pipes that are designed to fill with stormwater during large storm events and slowly release it back into stormwater conveyance systems over a number of hours.
Water quality inlet	Systems that contain one or more chambers that promote sedimentation of coarse materials and separation of undissolved oil and grease from stormwater.

[1] This is not an inclusive list.

[2] The definitions were obtained from the following sources: (1) Stormwater Best Management Practice Handbook: Municipal, CASQA 2003; (2) Stormwater Management Manual, City of Portland Environmental Services, 2002; (3) Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County, Attachment 4: Final Draft Well Standard, Santa Clara Valley Water District, 2003.

[3] A storm water infiltration device is any structure that is designed to infiltrate storm water into the subsurface and, as designed, bypasses the natural groundwater protection afforded by surface soil. The definition of storm water infiltration device does not include any type of septic system or other waste water disposal system, any infiltration of water other than storm water, District percolation ponds, lined sumps and basins, or any naturally-occurring body of surface water.

Attachment III-4 provides a list of manufactured stormwater control vendors.

Select Stormwater Treatment BMPs to Remove Pollutant of Concern. The stormwater treatment BMPs chosen should remove the primary pollutants of concern generated by the proposed project's land uses. Table III.2 lists pollutant sources categorized by land use and lists the typical pollutants generated by the land use activity.

Table III.2
Pollutants Generated by Land Use Activity

Project Pollutant Sources	Pollutants of Concern
Lawns, Landscaping, and Parks	Sediment (coarse and fine) Nutrients (dissolved and particulate) Pesticides, pathogens, trash & debris
Parking Lots and Driveways	Sediment (fine) Metals (dissolved and particulate) TPH, Trash
Arterials and Highways	Sediment (coarse and fine) Metals (dissolved and particulate) TPH, PAHs, Trash & Debris
Food-Related Commercial	Pathogens, Oil & Grease, Trash
Animal-Related Commercial (e.g., dog grooming, horse stables)	Pathogens
Auto-related Commercial	Metals (dissolved and particulate) TPH, PAHs, Surfactants
Industrial	Sediment (coarse and fine) Metals (dissolved and particulate) TPH, PAHs, PCBs, pH, Surfactants
Agriculture	Sediment (coarse and fine) Nutrients (dissolved and particulate) Pesticides

Source: GeoSyntec Consultants, 2002

After determining the pollutants of concern for the proposed project, the applicant can choose an appropriate removal process and the pollutant removal treatment system(s). Table III.3 lists major pollutants of concern and indicates what process removes the pollutant in its various forms (e.g., course versus fine sediments). The table also groups treatment controls by the removal process employed.

Table III.3
Pollutant Removal Processes

Pollutant	Form	Removal Process	Treatment Control
Sediment: Trash and Debris	Coarse	Gravity Settling Filtration Hydro-Dynamic Settling	Wet Pond Extended Detention Pond Wetlands Wet Vault/Tank Bioswale, Vegetated Swale Filter Strip Hydrodynamic Separators Catch Basin Inserts
Sediment: including pollutants associated w/ fine sediment – metals, TPH, TP	Fine	Gravity Settling Filtration Coagulation/Precipitation	Wet Pond Wetlands Sand Filter Media Filter Infiltration Bioretention Polymer Treatment Electrocoagulation
Metals	Dissolved	Absorption/Adsorption Ion Exchange Biological Uptake	Wetlands Media Filter Infiltration Bioretention
Ammonia/nitrate	Dissolved	Nitrification/Denitrification Biological Uptake	Bioretention Wetlands Wetponds Biofilters
Phosphate	Dissolved	Precipitation Biological Uptake	Amended Sand Filter Media Filter
Pathogens	Suspended	Disinfection	Ozonation
Oil and Grease	Emulsified	Absorption/Adsorption	Bioretention Wetlands Media Filtration
Surfactants	Dissolved	Absorption/Adsorption	Bioretention Infiltration
Pesticides	Dissolved	Absorption/Adsorption	Bioretention Infiltration Media Filter

Source: GeoSyntec Consultants, 2002.

Effectiveness. A comparative summary of the effectiveness of various treatment BMP types at removing common pollutants based on these sources is located in Table III-4. The following resources provide detail on the removal effectiveness of various treatment BMPs:

- *National Pollutant Removal Performance Database for Stormwater Treatment Practices*, June 2000, Center for Watershed Protection (http://www.cwp.org).BMP National Stormwater Database, American Society of Civil Engineers (ASCE) (http://www.bmpdatabase.org/)
- CSUS Office of Water Programs: Storm Water Monitoring (http://www.stormwater.water-programs.com)

Table III.4
Treatment Control Performance

BMP Performance

BMP Type	BMP	Constituent/Performance										
		Coarse Sed.	Fine Sed	NO3	TN	TP	Pb (T)	Zn (T)	Cu (T)	Pathogens	Oil and Grease	Trash and Debris
Detention Basins	Wetpond	●	●	⊙	■	■	●	●	■	■	NR	●
	Extended Wetpond	●	●	■	■	●	●	●	●	■	NR	●
	Extended Drypond	●	■	⊙	■	⊙	■	■	■	⊙	NR	●
Water Quality Wetlands	Shallow Wetland	●	●	■	⊙	■	■	●	■	●	NR	●
	Extended Detention Wetland	●	●	■	⊙	■	■	●	■	●	NR	●

● Good ■ Fair ○ Poor
NR – Not recommended for treating this parameter without pretreatment due to high probability of system impairment.

Source: GeoSyntec Consultants, 2002.

Table III.4 (Continued)

Treatment Control Performance

BMP Performance

BMP Type	BMP	Constituent/Performance										
		Coarse Sed.	Fine Sed	NO3	TN	TP	Pb (T)	Zn (T)	Cu (T)	Pathogens	Oil and Grease	Trash and Debris
Biofilters (horizontal)	Bioswale	●	■	⊙	■	■	●	■	■	⊙	■	■
	Filter Strip	●	■	⊙	■	■	●	■	■	⊙	■	■
Filters (vertical)	Sand Filter	●	●	⊙	■	■	●	●	■	■	●	●
	Media Filter	●	●	⊙	■	■	●	●	●	■	■	NR
	Bioretention	●	●	⊙	●	●	●	●	●	⊙	●	NR
Solids Separator	Rotational Flow	●	■	⊙	■	■	■	■	■	⊙	●*	●
	Multi-Chamber	■	⊙	⊙	■	⊙	■	■	⊙	⊙	■	●
Inserts	Catch Basin Insert**	●	■	⊙	■	■	■	■	■	⊙	●*	●

● Good ■ Fair ⊙ Poor

NR – Not recommended for treating this parameter without pretreatment due to high probability of system impairment.

*Assumes that sorbent is placed in sedimentation chamber

****** The San Francisco Regional Board staff does not recommend the use of this BMP as it feels that it is ineffective.

Source: GeoSyntec Consultants, 2002.

Select Treatment BMPs To Fit Site Constraints. The slope, size of the drainage area, soils, and other site constraints affect the choice of treatment BMPs. Good landscape and site design will use these constraints as treatment opportunities. Selection of the best treatment BMP option will become self evident as the overall site is designed. The following examples demonstrate how stormwater treatment systems can fit a site and in many cases provide other enhancements.

Retention/Detention Basin. Either naturally occurring or the result of grading, landscapes with a slight concave slope (see picture above) have the ability to hold water and may be a good location for a retention/detention basin. This technique is more valuable in permeable soils but with proper outlets or underdrains this option can also be used in areas with heavy clay soils.

Grassy Swales. For large expanses of pavement such as parking lots (see picture above), use grass or vegetation lined swales (channels) as low maintenance linear biofilters.

Multiple Small Basins. Small vegetated retention basins (bioretention areas) may be installed in the parkway planting strip, along shoulders of streets, in parking lot planters, and at roof downspouts to support infiltration and treatment in a landscape. Use small basins to create opportunities for storage.

Extended Detention Basins. Detention basins are appropriate landscape elements for developments greater than ten acres and, when properly designed, can simultaneously serve as flood control basins, parks, playing fields, tennis courts, open space and overflow parking lots. Incorporate extended detention basins into landscape design to reduce the volume and velocity of runoff from the site, as well as to treat runoff.

Wet Ponds. Wet ponds are most cost effective in a development or project with a drainage area greater than ten (10) acres, but can be suitable with a drainage area greater than two (2) acres. Incorporate wet ponds into landscape design to enhance the drainage functions and aesthetic quality of the site. Combine wet ponds with recreational areas and surround by a fringe wetland to increase stormwater treatment potential.

Capital Cost Considerations. In general, capital costs are influenced by the type and size of the treatment BMP, whether it is located above or below ground and the land cost. Small, aboveground types of BMPs, like grassy swales, are less expensive than underground sand filters or infiltration trenches and large detention basins are less expensive than large wetlands, which involve specific plant types. Capital costs must be weighed against such factors as the treatment BMPs effectiveness at pollutant removal, maintenance costs, the likelihood that the treatment system will be maintained, and the potential for mosquito breeding. For additional information on comparative costs for various treatment control types, please see Attachment III-2 and the summary tables in Appendix D. These tables are based on studies done by the EPA and Caltrans on projects outside of the San Francisco Bay Area. Currently, capital cost data for the San Francisco Bay Area are limited.

Special Concerns With the Use of Infiltration Measures

Groundwater Quality Concerns. BMPs that allow rain and runoff to infiltrate into the soil help to reduce the amount of runoff from a development site and in some areas provide groundwater recharge. Infiltration measures that allow runoff to be filtered through surface soils, such as those incorporated into landscaping are encouraged where feasible. These include: vegetated swales and filter strips, bioretention, microdetention in landscaping, and pervious paving on surface soils.

Nonetheless, in some situations infiltration treatment systems can pose a risk of contaminating groundwater. Before approving their use, municipalities need to work with applicants to determine if the appropriate conditions exist for employing infiltration methods. Protecting groundwater quality is a major concern in the Santa Clara basin, where groundwater provides approximately half of the drinking water supply for 1.7 million residents. The Santa Clara Valley Water District strictly regulates the siting and construction of deep infiltration devices such as stormwater drainage wells.[4]

[4] SCVWD, 1993. "Stormwater Infiltration Devices", Supplement to "Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County", Attachment 4, Santa Clara Valley Water District Final Draft Well Standard.

Figure III-1 (page III-21) shows groundwater depths throughout Santa Clara Valley.

In general, the risks associated with infiltration can be managed by:

- Selecting stormwater treatment measures and other BMPs that are appropriate for the land use and location of the development site;
- Designing landscape drainage features so that they promote infiltration of runoff, but do not inject runoff or provide a direct conduit such that runoff bypasses the natural processes of filtering and transformation that occur in surface or near surface soils; and
- Taking steps to prevent the illegal discharge of wastes to drainage systems, including pollution prevention and source control BMPs.

Selection and Design of Infiltration Measures. In general, do not select infiltration measures for areas where any of the following conditions exist.

- Area is in proximity to or accepting runoff from locations used for chemical use or storage, washing, or waste disposal activities or is located where this may occur in the future;
- Surface and or subsurface soil of the area is contaminated (groundwater remediation site);
- Area has been recently disturbed and not stabilized or landscaped and therefore may have a high sediment load in the runoff; or,
- Soil does not permit infiltration measures to drain standing water within seventy-two (72) hours.

If the site is free of these general site conditions, municipalities must also confirm that the necessary design considerations have been met before approving the proposed infiltration measure. General design considerations for stormwater infiltration measures include:

- Infiltrate through surface or near surface soils;
- Incorporate underdrains to convey infiltrated stormwater to the storm drain if needed;
- Provide stormwater pretreatment (i.e. sediment removal) if needed; and
- Prevent illegal discharge into infiltration areas through education, signage (such as “No Dumping” stencils), and source controls.

Infiltration “devices” are measures designed to infiltrate stormwater into the subsurface and, as designed, bypass the natural groundwater protection afforded by surface soil. If infiltration devices are being considered for a site, applicants should know that special guidelines must be met for the following devices (definitions are in Table III.1).

- Dry wells;
- Infiltration basins;
- Infiltration and exfiltration trenches (includes french drains);
- Unlined retention basins (i.e., basins with no outlets); and

- Unlined or open-bottomed vaults or boxes installed below grade (includes bubble ups and permeable pavement with underground storage).
-

For additional guidelines on locating infiltration devices, please see Attachment III-3.

Ease of Inspection and Maintenance. Infiltration measures that disperse runoff over landscaped areas, or through permeable surfaces are the easiest types to inspect and maintain. In addition, these minimize the risks of illegal disposal because the surface is visible and the infiltration rate per unit area is relatively low. Below ground treatment units are more difficult and expensive to maintain because of access constraints. For more information on maintenance responsibilities, see Vector Control Considerations for Treatment Controls, next, and Chapter VI of this Handbook.

III.5 VECTOR CONTROL CONSIDERATIONS FOR STORMWATER CONTROLS

The Santa Clara Vector Control District (SCC VCD) has the responsibility for providing enforcement of mosquito control measures when public health is threatened. It is concerned with the spread of insects and other nuisance pests that could result from poorly designed and/or maintained structures, especially those containing standing water. Detention basins, water quality wetlands and infiltration basins are examples of stormwater treatment control structures that may offer prime breeding habitats for mosquitoes and other nuisance pests if not properly designed and maintained. Stagnant water associated with storm water treatment can provide habitat for the aquatic stages of mosquitoes. Santa Clara and other California vector control districts are particularly concerned that the expanding number of treatment controls may result in increased mosquito habitat at the same time as the potential arrival of West Nile Virus. SCVURPPP is working with the SCC VCD to develop favorable treatment control design standards.

Using Site Design to Minimize Mosquito Vector Control Concerns

Proper site design offers an excellent opportunity to minimize stormwater impacts and mosquito threats by minimizing the treatment controls needed, and by designing and placing those that are needed properly to reduce potential vector impacts.

Based on available literature and current BMP implementation strategies nationwide, the following general principles for proper site designs should be considered.

- **Preserve natural drainage**. This reduces the amount of stormwater runoff and provides for natural on-site runoff control. This can reduce the number of structural BMP measures required.
- **Improve designs of permanent pools**. Reduce mosquito habitat: increase circulation and provide deeper water depths. Stock permanently flooded

systems with mosquito fish to foster biological predation on mosquito larvae.

- **Select stormwater management measures based on site-specific conditions**. Designs that take into account site conditions tend to improve drainage and limit the occurrence of stagnant water.
- **Attend to ponds that temporarily impound water**. Facilities that pond water for an extended period (e.g., dry ponds, and man-made wetlands) should drain water completely within seventy-two (72) hours of a storm event. Avoid placement of dry ponds and underground structures in areas where they are likely to remain wet (i.e., high water tables). Principal outlets should have positive drainage. [5]
- **Properly design storm sewer systems**. The sheltered environment in-side storm drains can promote mosquito breeding. Design and construct pipes for a rate of flow that flushes the system of sediment and prevents water backing up in the pipe. Construct storm drains so that the invert out is at the same elevation as the interior bottom to prevent standing water.
- **Properly maintain controls.** Any circumstances that restrict the flow of water from a system as designed should be corrected. Debris or silt build-up obstructing an outfall structure should be removed. Under-drains and filtration media should be inspected periodically and cleaned out or replaced as needed.

Addressing Vector Control Considerations in Stormwater Treatment BMPs. While addressing stormwater quality via proper site design planning is the best method for minimizing long-term maintenance requirements and vector concerns, some projects still require stormwater treatment systems due to the size of the project. In such cases, project proponents should consider the following standards when selecting and designing these systems for their site. Municipalities should review proposed stormwater treatment BMPs designs with vector control in mind.

Proper BMP Designs to Reduce or Eliminate Mosquito Production. The Santa Clara County Vector Control District has identified several stormwater BMP maintenance objectives to reduce or eliminate mosquito production. These include the following:

- Minimize stagnant water (i.e., maintain constant exchange of water in systems);
- Minimize surface area (i.e., deeper water habitat is preferable);
- Keep wetland edges simple (e.g., steep banks with deep water);
- Prevent mosquito access to underground systems that may have standing water. Use siphons and sealed access to prevent mosquito access.

[5] "In Santa Clara County, there is not mosquito that will complete development in under seven days, even during the warmest conditions. Once the mosquito reaches the pupal stage, it can complete development without water as long as the soil remains damp. Therefore, a realistic limit on the duration of standing water is five days, even allowing for a considerable margin of error." Daniel Strickman, DEH-SC, May 3, 2004.

- Include mosquito net covering sand media filter pump sumps;
- Include aluminum "smoke proof" cover for any vault sedimentation basins;
- Use grouted rock energy dissipaters instead of loose rock; and
- Construct sites so that there is access to the water's surface. Any underground site that might create mosquito habitat in stagnant water should have easy access for direct inspection and insecticidal treatment.

Vector-control personnel throughout the United States have found that aquatic habitats that last only three (3) to five (5) days generally do not allow for complete development of mosquito larvae[6]. In addition, cold temperatures that often occur during the rainy season suppress mosquito production. In the Santa Clara Valley, with the exception of certain BMPs designed to hold permanent water (e.g. detention or wet ponds), all BMPs should drain completely within seventy-two (72) hours to effectively suppress vector production. Access for routine maintenance and vector control is also imperative in BMP design.

Improper BMP Design and Maintenance Can Lead to Additional Mosquito Production. Improper BMP selection, design, and maintenance contribute to mosquito production. Stormwater BMPs (and their associated structures and/or components) that may create a suitable habitat for mosquito production include:[7]

- Any BMP that clogs, improperly drains and/or collects debris;
- Catch basins and settling basins that are exposed;
- Effluent pipes with small diameter discharge orifices prone to clogging;
- Loose riprap;
- Pumps or motors designed to automatically drain water from structures;
- Retention ponds, continuous deflective separation (CDS) units, Delaware sand filters, multi-chambered treatment trains (MCTT), wet basins and other BMPs that maintain a pool of standing water;
- Sumps, catch basins and settling basins that are covered or located below ground;
- Sumps, catch basins, spreader troughs or other BMPs that do not drain completely; and,
- Underground detention systems, sumps or other BMPs that are unsealed or have openings.

Additional Resources For Guidance On Vector Controls

See Appendix E for additional vector control guidance. Additionally, the Program's website at www.scvurppp.org contains the following materials regarding mosquitoes and factors contributing to mosquito production within BMPs:

- *The Dark Side of Stormwater Runoff Management: Disease Vectors Associated with Structural BMPs;*

[6] Metzger et al., 2003.
[7] This list may not be totally inclusive of all stormwater BMPs that provide potential habitats for mosquitoes.

- *Stormwater Treatment Devices as Potential Breeding Grounds for Disease Carriers;*
- *Disease Vectors Associated with Stormwater Treatment Devices in California;*
- *The Downside of Stormwater Runoff Management: Disease Vectors & Structural BMPs in Southern California.*

III.6 PESTICIDE REDUCTION MEASURES

The SCVURPPP NPDES permit requires Co-permittees to discourage pesticide use at new development sites (Provision C.9.d.ii.) and requires reporting of these efforts when new developments meet the minimum area threshold for Provision C.3 (see Chapter II for details on the minimum area threshold). Pesticide reduction measures influence new development's landscape and structural design features, as well as the maintenance practices of the site's future owners. Ideally, an appropriately designed landscape reduces the potential for pesticides to run off the landscape; reduces or eliminates the amount of pesticides and other chemicals necessary to ensure healthy plants; and decreases the need for landscape maintenance by minimizing pest infestations and by creating low maintenance environments. Educational materials encourage property owners and their maintenance employees/contractors to consider maintenance techniques, such as integrated pest management, that stress less toxic pest control products and alternatives to chemical controls.

Pesticide Reduction Measures. When used as part of the development project review process, these measures can take the form of:

1. Conditions of approval to a proposed project's landscaping and building plans; and,
2. Fact sheets or other educational materials that are distributed to builders.

The Program developed model conditions of approval for landscaping plans, (Attachment III-1). The Program also created a fact sheet titled *Landscape Maintenance Techniques for Pest Reduction (*Attachment III-5). Other education fact sheets are also available on problem pesticides, integrated pest management (IPM), and controls for specific pests from the regional "Our Water Our World" (OWOW) store partnership outreach program. For additional outreach in both English and Spanish, see the OWOW IPM Fact Sheets on the Watershed Watch Site at http://www.watershedwatch.net/index_ipm.htm. (Click on "Got Bugs?" from the main page.)

Co-permittees are encouraged to add conditions of approval related to pesticide reduction (see Attachment III-1) during their review of landscape plans and to widely distribute the education fact sheets, perhaps as an attachment to planning application packets or grading and building permit forms. Due to site-specific constraints and concerns, there is no preferred or model list of pest-resistant plants, but municipal staff who review landscape plans may want to suggest the

IPM Fact Sheets

Ants	Aphids
Cockroaches	Fleas
Lawn	Weeds
Pests	Problem Pesticides
Pesticides & Water Quality	Use and Disposal of Pesticides
Roses	Snails and Slugs
Spiders	Yellow Jackets
Mosquitoes	Healthy Gardens

most hardy and appropriate plants for landscaping a particular site based on consultation with staff arborists, landscape plan experts, and IPM specialists. Ultimately, municipal staff is not required to enforce the implementation of pesticide reduction measures at new development or redevelopment projects during the post construction phase. However, the Co-permittees are required to keep track of the educational tools that they have provided regarding pest reduction measures. (See Chapter II and Attachment II-2 for recommendations on when to collect such data, and Chapter VII for the C.3 Data Form that can be used to collect such data.)

III.7 REFERENCES

SCVURPPP, June 1999. Technical Memorandum to Municipal Planning Department Personnel, from Dan Cloak and Wendy Edde, SCVURPPP, "Additional Considerations for Incorporating BASMAA's *Start at the Source* Techniques in Development Projects."

BASMAA, 1999. *Start at the Source: Design Guidance Manual for Stormwater Quality Protection*, Forbes Custom Publishing, NY.

California Regional Water Quality Control Board, San Francisco Bay Region, 1995. *Water Quality Control Plan for the San Francisco Bay Basin*,

SCVWD, 1993. "Stormwater Infiltration Devices", Supplement to "Standards for the Construction and Destruction of Wells and Other Deep Excavations in Santa Clara County", Attachment 4, Santa Clara Valley Water District Final Draft Well Standard.

California Regional Water Quality Control Board, San Francisco Bay Region, 2001. Order No. 01-119, NPDES Permit No. CAS029718, Amendment Revising Provision C.3. of Order No. 01-024, October 17, 2001.

GeoSyntec Consultants, "Design Session I – Treatment Control BMPs," APWA Stormwater Workshop 2002 – Current Issues for New and Redevelopment, Lisa Austin, November 14, 2002.

Larry Walker Associates, Inc. *Final Report Investigation of Structural Control Measures for New Development*, Prepared for Sacramento Stormwater Management Program, November 1999.

Figure III-1
Depth to First Groundwater for the Santa Clara Basin

SAN FRANCSICO SOUTH BAY
PALO ALTO
MOUNTAIN VIEW
LOS ALTOS
LOS ALTOS HILLS
SUNNYVALE
SANTA CLARA
MILPITAS
SAN JOSE
CUPERTINO
CAMPBELL
SARATOGA
MONTE SERENO
LOS GATOS
MORGAN HILL

Legend

Depth to First Groundwater
- 0 to 10 ft.
- 10 to 20 ft.
- 20 to 30 ft.
- 30 to 50 ft.
- 50 to 100 ft.
- Greater than 100
- No Data

- Street or Highway
- Stream
- Jurisdictional Boundary
- Upland Area

Data Source: Santa Clara Valley Water District
Revised March 2004

N

0 1 2 3 4 5 Miles

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

ATTACHMENT III-1

Santa Clara Valley Urban Runoff Pollution Prevention Program Model Conditions of Approval for Stormwater Quality

[Co-permittees May Replace with own documents]

Santa Clara Valley Urban Runoff Pollution Prevention Program
MODEL CONDITIONS OF APPROVAL FOR STORMWATER QUALITY

INTRODUCTION

The following list contains measures to control sources of storm water pollutants associated with the post-construction phase of new development and redevelopment projects. Each identified source of pollutants may have one or more appropriate control measures. The model list is intended to be a menu of measures from which Co-permittees may select appropriate measures to apply to specific projects. Co-permittees do not have to use the exact wording of a site design or source control measure as long as the intent of the measure (i.e., to keep pollutants out of storm water, groundwater, creeks and the Bay) is preserved. Phrases in brackets represent alternative or optional wording.

SITE DESIGN

General

1. The project will incorporate site design measures for reducing water quality impacts of the project, in compliance with the [City/Town's] NPDES stormwater permit Provision C.3. requirements. Guidance on approved site design measures is available from the [Public Works/Planning Department]. Final approval for site design measures must be obtained from the [Planning/Community Development/Public Works Department].

Minimize Land Disturbance

1. Significant natural features and resources on site such as undisturbed forest area, setbacks, easements, trees, steep slopes, erosive soils, wetlands or riparian areas shall be identified within the area to be developed and protected during construction and during future use of the site.
2. Site layout shall conform to natural landforms on-site. Buildings shall be located to utilize natural drainage systems as much as possible and avoid unnecessary disturbance of vegetation and soils. Development on unstable or easily erodible soils shall be avoided due to their greater erosion potential.

Minimize Impervious Surfaces

1. Directly connected impervious surfaces shall be minimized. Runoff from impervious areas shall be channeled to pervious areas (e.g., park strips, vegetated planters) where possible prior to discharge to the storm drain.
2. Site permeability shall be maximized by clustering buildings, reducing building footprints, minimizing impervious surfaces, and paving with permeable materials where feasible.
3. The project shall cluster structures and incorporate smaller lot sizes where feasible to reduce overall impervious surface coverage and provide more undisturbed open space, for protection of water resources.

Preserve Open Space

1. The amount of open space on the site shall be maximized and the open space area maintained in a natural manner.
2. Undisturbed natural areas such as forested conservation areas and stream buffers shall be utilized to treat and control stormwater runoff from other areas of the site with proper design.

Reduce Effects of Hydromodification

1. The project shall utilize infiltration measures to reduce stormwater discharge to the greatest extent feasible.
2. The applicant shall minimize increases in stormwater flow and volume resulting from the development project to protect creeks and waterways from flooding and erosion impacts.

Street Design

1. Where density, topography, soils, slope and safety issues permit, vegetated open channels or other landscape measures shall be used in the street right of way to convey and treat stormwater runoff from roadways.
2. Sidewalks shall be sloped to drain to adjacent vegetated park strips.

Parking Lots

1. Where feasible, parking lots and other impervious areas shall be designed to drain stormwater runoff to vegetated drainage swales, filter strips, and/or other treatment devices that can be integrated into required landscaping areas and traffic islands prior to discharge into storm drain systems.
2. The amount of impervious area associated with parking lots shall be minimized by providing compact car spaces, reducing stall dimensions, incorporating efficient parking lanes, and using permeable pavement in overflow parking areas where feasible.
3. Curb cuts (one every 10 feet), tire stops, or other means shall be provided to protect landscaped areas and allow maximum flow of stormwater into landscaped areas.
4. The use of permeable paving for parking and driveway surfaces is encouraged, to reduce runoff from the site. Such paving should meet fire department requirements and be structurally appropriate for the location.

Landscaping as a Stormwater Drainage/Treatment Feature

1. Projects shall be designed to direct stormwater runoff into landscaping or natural vegetation where feasible.
2. Large landscaped areas shall be designed to collect and infiltrate stormwater where feasible. Overflow drains shall be placed so that landscaped areas can store runoff and drain at capacity. Such collection areas shall be designed and maintained to meet vector control requirements.
3. Where possible, runoff from impervious areas such as rooftops, roadways and parking lots shall be directed to pervious areas, open channels or vegetated areas prior to discharge to the storm drain system.

Riparian Areas

1. Naturally vegetated buffers shall be delineated and preserved along perennial streams, rivers, lakes and wetlands.

SOURCE CONTROLS

Structural Control Measures

A. Illegal Dumping to Storm Drain Inlets and Waterways

1) On-site storm drain inlets shall be clearly marked with the words "No Dumping! Flows to Bay," or equivalent, using methods approved by the [Co-permittee].

2) It is unlawful to discharge any wastewater into storm drains, gutters, creeks, or the San Francisco Bay. Unlawful discharges to storm drains include, but are not limited to, discharges from toilets; sinks; industrial processes; cooling systems; boilers; fabric cleaning; equipment cleaning; or vehicle cleaning.

3) It is unlawful to cause hazardous domestic waste materials to be deposited in such a manner or location as to constitute a threatened discharge into storm drains, gutters, creeks or San Francisco Bay.

B. Interior Floor Drains

1) Interior floor drains shall be plumbed to the sanitary sewer system and shall not be connected to storm drains.

C. Parking Lots

1) Interior level parking garage floor drains shall be connected to [a water treatment device approved by the (Co-permittee) prior to discharging to] the sanitary sewer system. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

D. Pesticide/Fertilizer Application

1) Landscaping shall be designed to minimize irrigation and runoff, promote surface infiltration where appropriate, and minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.

2) Structures shall be designed to discourage the occurrence and entry of pests into buildings, thus minimizing the need for pesticides. For example, dumpster areas should be located away from occupied buildings, and building foundation vents shall be covered with screens.

3) Additional requirements are covered in the "Model Conditions of Approval for Pest Resistant Landscaping" (August 19, 2002).

E. Pool, Spa, and Fountain Discharges

1) Pool (including swimming pools, hot tubs, spas and fountains) discharge drains shall not be connected directly to the storm drain or sanitary sewer system. [Exception: Public pool discharge drains must be connected to the sanitary sewer system, per County Department of Environmental Health requirements.]

2) When draining is necessary, a hose or other temporary system shall be directed into a sanitary sewer clean out. The clean out shall be installed in a readily accessible area [example: within 10 feet of the pool]. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

F. Food Service Equipment Cleaning

1) Food service facilities (including restaurants and grocery stores) shall have a sink or other area for cleaning floor mats, containers, and equipment, that is connected to a grease interceptor prior to discharging to the sanitary sewer system. The cleaning area shall be large enough to clean the largest mat or piece of equipment to be cleaned. The cleaning area shall be indoors or in a covered area outdoors; both areas must be plumbed to the sanitary sewer.

G. Refuse Areas

1) New buildings [such as food service facilities and/or multi-family residential complexes or subdivisions] shall provide a covered or enclosed area for dumpsters and recycling containers. The area shall be designed to prevent water run-on to the area and runoff from the area.

2) Areas around trash enclosures, recycling areas, and/or food compactor enclosures shall not discharge to the storm drain system. Any drains installed in or beneath dumpsters, compactors, and tallow bin areas serving food service facilities shall be connected [to a grease removal device prior to discharging] to the sanitary sewer. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

H. Outdoor Process Activities/Equipment[1]

1) Process activities shall be performed either indoors or outdoors under cover. If performed outdoors, the area shall be designed to prevent run-on to and runoff from the site.

2) Process equipment areas shall drain to the sanitary sewer system. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

I. Outdoor Equipment/Materials Storage

1) All outdoor equipment and materials storage areas shall be covered [and bermed], or shall be designed to limit the potential for runoff to contact pollutants [or a storm drain inlet valves shall be provided on exterior drains in the area].

2) Storage areas containing non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners or vaults. . The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

3) All hazardous materials and wastes, as defined [or regulated] by [cite ordinance or regulation], on the site must be used and stored in compliance with the [Co-permittee's] Hazardous Materials Ordinance and Hazardous Materials Management Plan for the site approved by the [Co-permittee department].

J. Vehicle/Equipment Cleaning

1) Wastewater from vehicle and equipment washing operations shall not be discharged to the storm drain system. [Optional, e.g. for car dealerships: If water only (without soap or other cleaning agent) is used for rinsing of vehicle exterior surfaces for appearance purposes, the runoff may be discharged to the storm drain system.]

[1] Examples of businesses that may have outdoor process activities and equipment include machine shops and auto repair shops, and industries that have pretreatment facilities.

2) Commercial/industrial facilities having vehicle/equipment cleaning needs [and new residential complexes of 25 units or greater] shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses. Vehicle/equipment washing areas shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

3) Commercial car wash facilities shall be designed and operated such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer [or a wastewater reclamation system shall be installed]. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

K. Vehicle/Equipment Repair and Maintenance

1) Vehicle/equipment repair and maintenance shall be performed in a designated area indoors, or if such services must be performed outdoors, in an area designed to prevent the run-on and runoff of stormwater.

2) Secondary containment shall be provided for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.

3) Vehicle service facilities shall not contain floor drains unless the floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer, for which an industrial waste discharge permit has been obtained. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

4) Tanks, containers or sinks used for parts cleaning or rinsing shall not be connected to the storm drain system. Tanks, containers or sinks used for such purposes may only be connected to the sanitary sewer system if allowed by an industrial waste discharge permit. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

L. Fuel Dispensing Areas

1) Fueling areas[2] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.

2) Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area, as defined below[1].] The canopy [or cover] shall not drain onto the fueling area.

[2] The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.

M. Loading Docks

1) Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

2) Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.

3) Door skirts between the trailers and the building shall be installed to prevent exposure of loading activities to rain.

N. Fire Sprinkler Test Water

1) Sanitary sewer connections shall be provided to drain fire sprinkler test water.

O. Miscellaneous Drain or Wash Water

1) Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.

2) [Air compressor or air conditioner] condensate drain lines may not discharge to the storm drain system.

3) Roof drains shall discharge and drain away from the building foundation to an unpaved area wherever possible.

4) Roof top equipment shall drain to the sanitary sewer. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

Operational BMPs

A. Paved Sidewalks and Parking Lots

2) Sidewalks and parking lots shall be swept regularly to prevent the accumulation of litter and debris. Debris resulting from pressure washing shall be trapped and collected to prevent entry into the storm drain system. Washwater containing any cleaning agent or degreaser shall be collected and discharged to the sanitary sewer and shall not be discharged to a storm drain. The applicant shall contact the local permitting authority and/or sanitary district with jurisdiction for specific connection and discharge requirements.

B. Private Streets

1) Owner of private streets and storm drains shall prepare and implement a plan for street sweeping of paved private roads and cleaning of all storm drain inlets.

C. Vehicle/Equipment Repair and Maintenance

5) No person shall dispose of, nor permit the disposal, directly or indirectly, of vehicle fluids, hazardous materials, or rinsewater from parts cleaning operations into storm drains.

6) No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any

spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.

7) No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.

D. Fueling Areas

The property owner shall dry sweep the fueling area routinely.

PESTICIDE REDUCTION

If a landscaping plan is required as part of a development project application, the plan shall meet the following conditions related to reduction of pesticide use on the project site:

1. Landscaping shall be designed with efficient irrigation to reduce runoff, promote surface infiltration, and minimize the use of fertilizers and pesticides that can contribute to water pollution.
2. Where feasible, landscaping shall be designed and operated to treat stormwater runoff by incorporating elements that collect, detain, and infiltrate runoff. (Attachment A, "Examples of Landscaping Element for Stormwater Treatment" shall be used as a reference.) In areas that provide detention of water, plants that are tolerant of saturated soil conditions and prolonged exposure to water shall be specified.
3. Plant materials selected shall be appropriate to site specific characteristics such as soil type, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plant interactions to ensure successful establishment.
4. Existing native trees, shrubs, and ground cover shall be retained and incorporated into the landscape plan to the maximum extent possible.
5. Proper maintenance of landscaping, with minimal pesticide use, shall be the responsibility of the property owner. ("Fact Sheet on Landscape Maintenance Techniques for Pest Reduction" may be used as an example education piece for property owners.)

REFERENCES

Site Design

Atlanta Regional Commission, *Georgia Stormwater Management Manual Volume 2 (Technical Handbook),* August 2001

City of Palo Alto, Municipal Code Title 18.12.050 Site Development Regulations.

City of Portland Environmental Services, *Stormwater Management Manual,* September 2002.

City of San Bruno Community and Economic Development Department, *San Bruno Redevelopment Project Area Plan Draft Environmental Impact Report,* prepared by Environmental Science Associates, March 1999.

City of Sunnyvale, *Industrial Pretreatment/Urban Runoff Program,* August 1998.

San Mateo Countywide Stormwater Pollution Prevention Program New Development Subcommittee, *Model Development Policies,* May 2001.

Washington State Department of Ecology, *Stormwater Management Manual for Western Washington*, August 2001.

Source Control

BASMAA "Start at the Source Tools Handbook" (June 2000);

Alameda Countywide Clean Water Program (ACCWP) Model Conditions of Approval (1999);

City of Palo Alto Municipal Code Chapter 16.09, and revisions to Chapter 16.09 approved July 22, 2002;

City of San Jose standard conditions (need reference);

City of Cupertino, Guidance for Selecting BMPs for Development Projects;

Example source control measures provided by Regional Board staff in Provision C.3.k. of the SCVURPPP NPDES Permit (October 2001).

Pesticide Reduction

Alameda Countywide Clean Water Program, Model Conditions of Approval, 1999.

City of Concord, North Carolina, *Unified Development Ordinance*, "Article 7, Landscaping and Buffering Standards" http://www.ci.concord.nc.us/planning/zoning/acrobats/Article%207.pdf,

IPM Access, Integrated Pest Management Information Service, www.efn.org/~ipmpa, *IPM Based Landscape Design.*

IPM Access, Integrated Pest Management Information Service, www.efn.org/~ipmpa, *Fundamentals of a Low Maintenance, Integrated Pest Management Approach to Landscape Design.*

King County Local Hazardous Waste Management Program, *Tri-County Integrated Pest and Vegetation Management: Guidelines.*

ATTACHMENT III-1A

LANDSCAPING ELEMENTS FOR STORMWATER TREATMENT

Landscaped areas in development sites present valuable opportunities to treat and store runoff. Through a variety of strategies, the volume of runoff and concentration of pollutants found in the runoff from development sites can be minimized, resulting in improved quality of waters discharged into local creeks and the Bay.

A particular concern with landscaped areas is the use of pesticide products for landscape maintenance. Alternative design and maintenance techniques can reduce the potential for pesticides to run off the landscape; reduce the amount of chemicals necessary to ensure healthy plants or eliminate the need for pesticide usage; and decrease the need for landscape maintenance by minimizing pest infestations and creating low maintenance environments. Using these techniques decreases the amount of pesticides entering receiving waters.

The planning and design phases of development present ideal opportunities for inclusion of stormwater treatment into landscape design. It is important to make such considerations early in the development process to ensure effective incorporation and plan for maintenance measures. Described below are suggestions for various stages in the development process. These methods are enumerated in more detail in BASMAA's Start at the Source Design Guidance Manual for Stormwater Quality Protection (1999).

PLANNING

Identify sensitive areas to be protected and preserved during construction, such as existing trees, steep slopes, erosive soils, riparian areas or wetlands when planning for site development (Start at the Source, p. 28).

DESIGN

Utilize drainage as a design element in site plan development. Whenever possible, natural drainage systems should guide the pattern of development and influence site layout of pathways, parks and open areas, and building structures. Integrating naturally occurring drainage systems into site design will yield aesthetic and functional benefits (Start at the Source, p. 32). Suggested methods include:

A. Maximizing Permeability

1. Minimizing Directly Connected Impervious Surface Area

   Impervious surfaces that are directly connected to the stormwater conveyance system do not take advantage of the potential benefits offered by the infiltration of runoff and filtration of pollutants by plant and soil materials. Direct runoff from pathways to landscaped areas. (Start at the Source, p. 29)

2. Permeable Pavement

   When development requires the installment of hard, flat surfaces, porous pavement may be utilized instead of impervious surfaces. Permeable pavement minimizes runoff by allowing the infiltration of water through a load bearing surface where it is stored in an underground

reservoir. The materials listed below may be used as porous pavement. (*Start at the Source*, p. 47)

a. Pervious concrete
b. Porous asphalt
c. Turf block
d. Brick
e. Natural stone
f. Concrete unit paver
g. Crushed aggregate (gravel)
h. Cobbles
i. Wood mulch (for light pedestrian use)

B. Utilizing Treatment Opportunities (Start at the Source, p. 70-73)

1. Landscape Grading

   Landscapes that have a slight concave slope have the ability to hold water. This technique is more valuable in permeable soils but can be used as retention/detention basins with proper outlets or underdrains in heavy clay soils.

2. Grass Swales

   Grass or vegetation lined swales (channels) can be used as low maintenance linear biofilters along the perimeters of large expanses of pavement. (e.g., parking lots)

3. Multiple Small Basins

   Small vegetated retention basins (bioretention areas) can to used to create opportunities for storage, infiltration, and treatment in a landscape. Small basins may be installed in the parkway planting strip, along shoulders of streets, under wood decks, in parking lot planters, and at roof downspouts.

4. Extended Detention Basins

   Extended detention basins can be incorporated into landscape design to reduce the volume and velocity of runoff from the site. Detention basins are appropriate landscape elements for developments greater than ten acres and can simultaneously serve as flood control basins, parks, playing fields, tennis courts, open space and overflow parking lots.

5. Wet Ponds

   Permanent pools of water that detain and treat stormwater runoff, wet ponds can be incorporated into landscape design to enhance the drainage functions and aesthetic quality of the site. Wet ponds are often surrounded by a fringe wetland to increase stormwater treatment potential and can also be combined with recreational areas (usually appropriate for storm water drainage in a development or project with a drainage area greater than 2 acres but more cost effective for drainage areas greater than 10 acres).

6. Increase the Treatment Potential of the Landscape

   The beneficial stormwater detention and treatment elements of a landscape can be optimized by:

   a. Planting deeply rooted plants that help build soil porosity;

   b. Allowing exposed leaf surface to collect rainwater before it filters into the soil in order to increase overall detention potential; and

   c. Selecting plants appropriate for the site climate, exposure, and amount of watering or inundation by water.

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

ATTACHMENT III-2

Santa Clara Valley Urban Runoff Pollution Prevention Program Selection Matrix for Stormwater Quality Measures

SITE DESIGN MEASURE SELECTION MATRIX

	Reference		Design Objective						Application					NRCS Hydrologic Soil Group				Effectiveness	Constraints		Costs		Type		Philosophy			Notes
Control Measure	BASMAA's Start at the Source (1999)	CA BMP Handbook (2003)	Infiltration	Retention	Slow Runoff	Minimize Impervious Surface Area	Contain Pollutants	Collect and Convey	Residential	Commercial	Industrial,RGO	Parking Lot	Other	A (Gravel/ Sand)	B (Loam)	C (Silt Loam)	D (Clay Loam, Sandy Clay, Clay)		Suitable for Slopes?	Locations to Avoid	Construction	Maintenance	Flow-through Treatment	Volume-based Treatment	Zero Discharge	Self-Treating	Runoff Reduction	
Permeable Pavement Materials																												
Pervious Concrete	47-48; 101	SD-20	✓	✓	✓	✓	✓		✓	✓		✓	(1)	✓	✓	✓	P	H	≤ 5%	Gas stations, truck stops, high HC areas, high traffic areas.	1.5 X conventional concrete (2)	1-2% construction costs/year		✓			✓	(1) Low traffic volume bikeways, streets, travel lanes, parking stalls, residential driveways, patios. (2) Cost can be offset by not having to install curb and gutter drainage system.
Porous Asphalt	48-49; 102-103	SD-20	✓	✓	✓	✓	✓		✓	✓		✓	(3)	✓	✓	✓	P	H	≤ 5%	Gas stations, truck stops, high HC areas, high traffic areas.	1.5 X conventional concrete (2)	1-2% construction costs/year		✓			✓	(2) Cost can be offset by not having to install curb and gutter drainage system. (3) Low traffic volume parking lots, travel lanes, parking stalls.
Turf Block	50; 104	SD-20	✓	✓	✓	✓	✓		✓	✓		✓	(4)	✓	✓	✓	P	H	≤ 5%	All day parking, heavy use, areas with turning movements.	$4-6/sq. ft, installed.	Comparable to lawn.		✓		✓	✓	(4) Low flow traffic/infrequent parking: res. driveways, overflow parking areas, outer 1/3 comm/retail developments; emergency access roads, utility roads, street shoulders, swales.
Brick, Natural Stone, Concrete Unit Pavers on Sand	50-52; 104-107	SD-20	✓	✓	✓	✓	✓		✓	✓			(5)	✓	✓	✓	P	M	≤ 5%	High erosive areas.	$6-10/sq. ft. brick; $10-25/sq. ft. stone; $9-15/sq.ft concrete unit paver	Easy to repair. Occasional weed suppression.		✓			✓	(5) Driveways, walkways, patios, plazas, parking stalls.
Crushed Aggregate (gravel)	52; 108	SD-20	✓	✓	✓	✓	✓		✓	✓		✓	(6)	✓	✓	✓	✓	H		ADA-compliant accessible paths of travel. High erosive areas. High trafffic volume/speed areas.	$1-$3/sq. ft.	Easy to repair. Occasional weed suppression.		✓			✓	(6) Driveways, walkways, patios, public sidewalks, plazas, low volume streets, low-use parking stalls.
Cobbles Set in Soils	53; 109	SD-20	✓	✓	✓	✓	✓		✓	✓			(7)	✓	✓	✓	✓	M		Walkway surfaces.	Variable on material.	Easy to repair. Occasional weed suppression.		✓			✓	(7) Garden areas, parkway planter strips, median islands, under trees.
Streets																												
Narrow Access Street (urban & rural)	54-57; 111-114		P	P	✓	✓			✓	✓				✓	✓	✓	✓	H	Not for hillside sites with high fire risks	>500-750 ADT; >15-25 mph; long cul-de-sac streets.	Design. Less cost for materials.	Standard + Landscaping.	NA	NA			✓	Properties on tree-lined narrower streets command higher values typically.
Street Swale Systems	57-58; 115-116		✓		✓				✓	✓			arterial streets, concave medians	✓	✓	✓	P	H	✓		Design. Less cost for materials.	Standard + Landscaping and sediment removal.	✓				✓	
Dual Drainage System	58-59; 117		✓		✓		✓		✓	✓			arterial streets, concave medians	✓	✓	✓	✓	H	✓	Industrial areas/ potential spills.	More expensive; multiple elements	More expensive; multiple elements	✓				✓	
Concave Median	59; 118		✓	✓					✓	✓	✓	✓	where would have convex medians	✓	✓	✓	P	H	✓		Similar to convex planted medians.	Similar to convex planted medians	✓	✓	✓	✓	✓	
Cul-de-sacs, landscaped	60; 119		P	P		✓			✓	✓			Institutional, cul-de-sac streets	✓	✓	✓	P	H	✓		Cost to extend storm drain the length of the cul-de-sac; landscaping.	Similar to planted medians	✓	✓	✓	✓	✓	
Parking Lots																												

SITE DESIGN MEASURE SELECTION MATRIX

	Reference		Design Objective						Application					NRCS Hydrologic Soil Group				Effectiveness	Constraints		Costs		Type		Philosophy			Notes
Control Measure	**BASMAA's Start at the Source (1999)**	**CA BMP Handbook (2003)**	**Infiltration**	**Retention**	**Slow Runoff**	**Minimize Impervious Surface Area**	**Contain Pollutants**	**Collect and Convey**	**Residential**	**Commercial**	**Industrial,RGO**	**Parking Lot**	**Other**	**A (Gravel/ Sand)**	**B (Loam)**	**C (Silt Loam)**	**D (Clay Loam, Sandy Clay, Clay)**		**Suitable for Slopes?**	**Locations to Avoid**	**Construction**	**Maintenance**	**Flow-through Treatment**	**Volume-based Treatment**	**Zero Discharge**	**Self-Treating**	**Runoff Reduction**	
Hybrid Parking Lot/Parking Grove/ Overflow Parking	61-63; 121-124					✓			✓	✓		✓	Parking groves best for MFR or offices, or hotels.	✓	✓	✓	✓	M,L,M	≤ 5%	High groundwater or lack of deep permeable soils may limit applicability. Parking groves not recommended for high turnover lots (res., retail. areas).	Variable dependent on materials selected.	✓		✓		(8)	✓	(8) Overflow parking may be used as part of a self-treating area
Porous Pavement Recharge Bed	63; 125		✓		✓							✓	Underneath parking lots where land values are high	✓	✓	✓	✓	H	✓	Areas with poor soil infiltration rates; high groundwater table, depth to bedrock; areas of high or heavy traffic.	Expensive, requires extensive engineering	Yes, 2 times/year		✓	✓		✓	
Driveways																												
Driveways sloped to landscaping	64; 127				✓		✓		✓	✓	✓			✓	✓	✓	P	H	Cross slope must be >longitudinal slope	Areas where suitably-sized adjacent landscaped area is not available.	Same as conventional	Same as conventional	✓					Ensure driveway edge 3 inches above vegetated area.
Crushed Aggregate Driveways	64; 128				✓				✓				Light use driveways	✓	✓	✓	✓	H	< 5%	Multi-use driveways/play areas.	$1-$3/sq.ft.	Weed control, replenishment of aggregate.		✓			✓	
Unit Pavers on Sand/ Temp. Parking	65-66; 129; 132		✓						✓	✓				✓	✓	✓	P	M	< 5%	Expansive soils without special subgrade preparation. Highly erosive areas require more maintenance.	$9-15/sq. ft installation	Easy to repair.		✓			✓	
Paving Only Under Wheels	65; 130					✓			✓					✓	✓	✓	✓	H	✓	Curving driveways	Reduced construction costs	✓		✓		✓	✓	
Flared Driveways	66; 131					✓			✓				Multi-car garages	✓	✓	✓	✓	H	✓	Areas requiring multilane width along entire length	Reduced materials costs	Same		✓			✓	
Temporary Parking	66; 132					✓			✓				Guest Parking; Areas where infrequent parking or loading access is required.	✓	✓	✓	✓	H	Flat to gentle	High use areas	Higher initial than asphalt/ concrete	✓		✓			✓	Design to support vehicle loads
Roof Runoff																												
Dry-well	67; 134	SD-11	✓	✓			✓		✓	✓	✓			✓	✓		No	H	≤ 40%	Within 10 ft. bldg.	Relatively inexpensive	Relatively inexpensive		✓	✓	✓	✓	
Cistern or Rain Barrels	67-68; 135	SD-11		✓	✓		✓		✓	✓	✓			✓	✓	✓	✓	M	✓		Low	Regular monitoring/cleaning.	✓	✓	✓	✓	✓	Design to be vector, child-proof
Foundation Planting	68; 136	SD-11	✓		✓				✓	✓	✓		Buildings that do not use gutters	✓	✓	✓	P	H	✓	Bldgs with gutter system	Low	Regular gardening	✓	✓			✓	Can use underdrains for soils
Pop-up Drainage Emitter	68; 137	SD-11	✓		✓				✓	✓	✓			✓	✓	✓	P	H		Must be at least 10 ft. away from the bldg.	$12-$20 each plus pipe	Standard	✓				✓	
Green Roofs (vegetation on roof)		SD-21	✓	✓	✓	✓	✓		✓	✓	✓			✓	✓	✓	✓	H	✓	Redevelopment of buildings not structurally designed to handle the weight.	Similar to high end slate/tile	Irrigate/mow roughly once/year. 40 yr warranty on membrane		✓		✓	✓	Reduces urban heat island effect, cooling costs, noise.
Blue Roofs (water storage on roof)		SD-21			✓				✓	✓	✓			✓	✓	✓	✓	H	✓	Redevelopment of buildings not structurally designed to handle the weight.				✓				

Sources:

BASMAA, Start at the Source, 1999.
BASMAA, Using Site Design Techniques to Meet Development Standards for Stormwater Quality--A Companion Document to Start at the Source, May 2003
California Stormwater Quality Association, Stormwater Best Management Practice Handbook--New Development and Redevelopment, 2003.
SCVURPPP Program Staff, professional judgment, February 2004.

SITE DESIGN MEASURE SELECTION MATRIX

	Reference		Design Objective						Application					NRCS Hydrologic Soil Group				Effectiveness	Constraints		Costs		Type		Philosophy			Notes
Control Measure	BASMAA's Start at the Source (1999)	CA BMP Handbook (2003)	Infiltration	Retention	Slow Runoff	Minimize Impervious Surface Area	Contain Pollutants	Collect and Convey	Residential	Commercial	Industrial,RGO	Parking Lot	Other	A (Gravel/ Sand)	B (Loam)	C (Silt Loam)	D (Clay Loam, Sandy Clay, Clay)		Suitable for Slopes?	Locations to Avoid	Construction	Maintenance	Flow-through Treatment	Volume-based Treatment	Zero Discharge	Self-Treating	Runoff Reduction	
Notes:	H	High																										
	M	Medium																										
	L	Low																										
	P	Potential																										
	✓	Yes																										

SANTA CLARA VALLEY
URBAN RUNOFF
POLLUTION PREVENTION PROGRAM

STORMWATER TREATMENT CONTROL SELECTION MATRIX

	Reference		Targeted Constituents Removal Effectiveness							Application					NRCS Hydrologic Soil Group				Applicability			Costs		Type		Notes
Control Measure	**BASMAA's Start at the Source (1999)**	**CA BMP Handbook (2003)**	**Sediment**	**Nutrients**	**Trash**	**Metals**	**Bacteria**	**Oil and Grease**	**Organics**	**Residential**	**Commercial**	**Industrial, RGO**	**Parking Lots**	**Other**	**A (Gravel/ Sand)**	**B (Loam)**	**C (Silt Loam)**	**D (Clay Loam, Sandy Clay, Clay)**	**Goundwater Level a Concern?**	**Locations to Avoid**	**Potential for Mosquito/Vector Concerns**	**Construction**	**Maintenance**	**Flow-through Treatment**	**Volume-based Treatment**	
Infiltration																										
Infiltration Trench		TC-10	H	H	H	H	H	H	H	✓	✓	No	✓		✓	✓	P	P	✓	Slopes>15% (1). Fill sites; Where spills may occur.	✓ if clogged	$5 per ft3 new; $50/ft3 retrofit.	20% of construction cost		✓	(1) Risk of groundwater contamination in very coarse soils
Infiltration Basin		TC-11	H	H	H	H	H	H	H	✓	✓	No			✓	✓	P	P	✓	Slopes> 15% (2). Fill sites; Where spills may occur.	✓ if clogged	$2/ft./0.25 ac basing; $18/ft3 for 0.34 ac.ft.	5-10% of construction		✓	(2) Risk of groundwater contamination in very coarse soils
Retention/Irrigation		TC-12	H	H	H	H	H	H	H		✓			(3)	✓	✓	✓	✓	✓	<100 ft. from wells, septic systems, natural wetlands; <12 inches soil; Areas without open space (4).	✓	Not Available	High (inspections, mechanical equipment, power)		✓	(3) Recreational and greenbelt areas. (4) Best for areas with infrequent rainfall. Design Philosophy: Zero Discharge.
Detention and Settling																										
Constructed Wetland		TC-21	H	M	H	H	H	H	H	✓				(5)	No	✓	✓	✓		Steep unstable slopes	✓	$57,100/1 ac-ft facility; $1.47 mil/100 ac-ft facility,	3-5% of construction cost	✓	✓	(5) Where high nutrient load potential problem (e.g. golf courses).
Extended Detention (dry) Ponds	71; 142-143	TC-22	M	L	H	M	M	M	M	✓			✓	(6)	P (7)	✓	✓	✓	✓	Tight spaces. Areas without hydraulic head.	✓	$41,600/ 1 ac-ft pond; $239,000/10 ac-ft pond	3-5% of construction cost		✓	(6) Minimum 5 acre site (7) w/design modification Note: Design Philosophy: Zero Discharge, Self-treating; Runoff reduction
Wet Ponds	71; 144-145	TC-20	H	M	H	H	H	H	H	✓	✓			(8)	✓	✓	✓	✓		Steep unstable slopes	✓	$45,700/ac-ft facility; $1.17 mil/ 100ac-ft facility	3-5% of construction cost		✓	(8) Not in arid regions. Note: Design Philosophy: Zero Discharge, self-treating; runoff reduction
Manufactured Wetland		MP-20	✓	✓	✓	✓	✓	✓	✓	✓	✓				No	✓	✓	✓			✓	Variable	Variable	✓	✓	
Biofiltration																										
Vegetated Swales	71; 139-141	TC-30	M	L	L	M	L	M	M	✓	✓		✓		✓	✓	✓	✓		Slopes > 6%. Steep topography. Heavily gopher-populated areas. Certain industrial.	✓	$0.50/sq.ft. total	$0.75/linear foot per year. $2,700/ 2 ha drainage area.	✓	✓	Design Philosophy: Self-treating; Runoff reduction
Vegetated Buffer Strip		TC-31	H	L	M	H	L	H	M	✓	✓		✓	(9)	✓	✓	✓	✓		Slopes >15%. Tight spaces Certain industrial.	✓	$.30/sq ft. seed; $.70/sq ft. sod.	$350/ac/yr.	✓		(9) Roads, highways, roof downspouts, small parking lots, pervious surfaces.
Bioretention		TC-32	H	M	H	H	H	H	H	✓	✓	✓	✓	(10)	✓	✓	✓	P	✓	Slopes > 20%. Unstable soil stratum	✓	$3-$4/sq ft. Res; $10-$40/sq.ft. Other; $6,500/area retrofitted.	Comparable to typical landscaping.		✓	(10) Institutional. Design Philosophy: Zero-Discharge, Self-treating; Runoff reduction
Filtration																										
Media Filter		TC-40	H	L	H	H	M	H	H	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓ (11)	Unstable soils lead to clogs. large sites>25 acres; < 4 feet head.	✓	Variable $18,500 (1997 $) to $240,000	5% of construction	✓		(11) Can design to prevent contact with groundwater.
Manufactured Media Filter		MP-40	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Per design	Unstable soils lead to clogs	✓	Variable	Variable	✓		
Flow Through Separation																										
Water Quality Inlet		TC-50	L	L	M	L	L	M	L		✓	✓	✓		✓	✓	✓	✓	Per design	Unvegetated areas	✓	>2,000-$3,000	$125,000-$150,000/vactor truck	✓		Should be used only when no other BMP is feasible.
Manufactured Wet Vault		MP-50	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	Per design		✓	Variable	Variable. (12)	✓		(12) Subsurface control maintenance costs<surface (landscaping); manufactured< public domain (confined space)

STORMWATER TREATMENT CONTROL SELECTION MATRIX

	Reference		Targeted Constituents Removal Effectiveness							Application					NRCS Hydrologic Soil Group				Applicability			Costs		Type		Notes
Control Measure	**BASMAA's Start at the Source (1999)**	**CA BMP Handbook (2003)**	**Sediment**	**Nutrients**	**Trash**	**Metals**	**Bacteria**	**Oil and Grease**	**Organics**	**Residential**	**Commercial**	**Industrial, RGO**	**Parking Lots**	**Other**	**A (Gravel/ Sand)**	**B (Loam)**	**C (Silt Loam)**	**D (Clay Loam, Sandy Clay, Clay)**	**Goundwater Level a Concern?**	**Locations to Avoid**	**Potential for Mosquito/Vector Concerns**	**Construction**	**Maintenance**	**Flow-through Treatment**	**Volume-based Treatment**	
Manufactured Vortex Separator		MP-51	M	L	✓	L		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	Per design		✓	Variable	Variable	✓		
Manufactured Drain Inserts		MP-52	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	Per design	Large areas; Areas with Trash/Leaves.	✓	<$100-$2,000/ insert	High frequency, high costs	✓		Use only in retrofit situations or pretreatment of other BMPs.
Other																										
Multiple Systems		TC-60	H	L	H	H	M	H	H	P	P	P	P	P	P	P	P	P	See individual	Tight land areas	✓	Variable	Sum of individuals	P	P	

Sources:
BASMAA, Start at the Source, 1999.
BASMAA, Using Site Design Techniques to Meet Development Standards for Stormwater Quality--A Companion Document to Start at the Source, May 2003
California Stormwater Quality Association, Stormwater Best Management Practice Handbook--New Development and Redevelopment, 2003.
SCVURPPP Program Staff, professional judgment, February 2004.

Notes:
H High
M Medium
L Low
P Potential
✓ Yes

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

ATTACHMENT III-3

SCVURPPP Guidelines for Infiltration Devices

Attachment III-3

SCVURPPP Guidelines for Infiltration Devices (Rev. Draft 9-11-03)[1]

Siting / Design Parameter	Land Use Category I: Single Lot Residential	Land Use Category II: Residential Subdivision, Commercial, and Transportation
Groundwater separation (default)	>10 feet	>30 feet
Drainage Area	<5,000 sq. ft	<10,000 sq. ft.
Land use activities (occurring in drainage area to infiltration device)	Residential activities only.	No high risk land uses, including industrial, automotive repair shops, car washes, fleet storage areas, nurseries, landfills, and agricultural uses; No hazardous materials, chemical storage, or waste disposal.
Level of vehicular traffic	Not Applicable	<25,000 ADT main roads; <15,000 ADT minor roads
Setbacks[2] – horizontal distance to:		
➢ Drinking water wells (active wells and abandoned wells that are not properly decommissioned)	>500 feet	>600 feet
➢ Septic systems	>100 feet	>100 feet
➢ Underground storage tanks with hazardous materials	>500 feet	>500 feet
Hillside stability	Slopes > 7% - recommend geotechnical stability analysis	Slopes > 7% - recommend geotechnical stability analysis
Pretreatment	None required[3]	Sediment removal required

[1] An infiltration device is defined as any structure that is designed to infiltrate storm water into the subsurface, and as designed, bypasses the natural groundwater protection afforded by surface or near surface soil. Infiltration devices that do not meet the design criteria described herein are recommended to be reviewed by the Santa Clara Valley Water District.

[2] Additional design guidelines will include guidance on setbacks to other stormwater infiltration devices and to horizontal conduits.

[3] Sediment removal is recommended at most sites for ease of maintenance and effective operation of the device.

ATTACHMENT III-4

Stormwater Treatment BMP Maintenance Companies
Manufactured Stormwater Control Vendors

Attachment III-4

Stormwater Treatment BMP Maintenance Companies Contacted In The Santa Clara Basin[1]

Company Name	Contact	Phone
Storm Water Inspection & Maintenance Services (SWIMS)	Ric Campos	925-516-8966
Drainage Protection Systems (DPS)	Ryan Bradford	800-579-8819
Revel Environmental Manufacturing (REM)	Charlie Fleischmann	888-526-4736

[1] Disclaimer. This list is provided as an information resource only. The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). Inclusion on the list should not be construed to be an endorsement by SCVURPPP. SCVURPPP does not guarantee that this list is all conclusive of vendors serving the Santa Clara Valley. Vendors not included on this list who would like their contact information included in future updates or materials may contact Jill Bicknell at (408) 720-8811 or jcbicknell@eoainc.com.

List of Manufactured Stormwater Control Vendors

Company Name[2]	Vendor Information/Company Information	Product descriptions
Remedial Solutions, Inc/ AquaShield http://www.aquashieldinc.com	Andy Gersen Matzke Company Longview, WA 98632 206-595-2203 2626 Greenway Ave. Andy@isomedia.com	The Aqua-Guard™ Catch Basin Insert works to remove gross contaminants, oil and sediment at the source. The Aqua-Filter™ Stormwater Filtration System is an in-line stormwater filtration system capable of gross contaminant removal, and the removal of fine sediments, water-borne hydrocarbons, heavy metals (i.e. zinc) and nutrients such as phosphorous and nitrogen.
Bay Saver, Inc. California Concrete and Pipe (CA Vendors for Bay Saver) http://www.baysaver.com	Paul McWhorter 2960 South Hwy. 99 Stockton, CA 95215 800-314-7473 paul.mcwhorter@oldcastleprecast.com	BaySaver stormwater treatment systems are structural best management practice offering pollutant removal.
Continuous Deflective Separation Technologies, Inc .http://www.cdstech.com/	Gary Lippner 4813 El Camino Ave. Suite C Carmichael, CA 95608 916-486-1736 p 916-481-6836 f glippner@cdstech.com	Continuous Deflection Separation units CDS units remove sediments, gross debris, floatables, neutrally buoyant debris and remove free oil and grease.
United Stormwater, Inc http://www.unitedstormwater.com		The DrainPac is a catchment and filtration system. The retrofit design is designed to contain contaminants and debris prior to discharge into storm drain systems.
Ero-Con	Tom Schneider Dallas, TX 800-891-0473	Filters
KriStar Enterprises, Inc http://www.kristar.com	Sue Lillo 800-579-8819	A device installed in a new or existing oil/water separator tank that acts as a polishing filter for petroleum hydrocarbons.

[2] Disclaimer. This list is provided as an information resource only. The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). Inclusion on the list should not be construed to be an endorsement by SCVURPPP. SCVURPPP does not guarantee that this list is all conclusive of vendors serving the Santa Clara Valley. Vendors not included on this list who would like their contact information included in future updates or materials may contact Jill Bicknell at (408) 720-8811 or jcbicknell@eoainc.com.

Company Name[2]	Vendor Information/Company Information	Product descriptions
Altech Technology Systems, Inc http://www.altech-group.com	Mr. Alex R. Keen, President 12 Banigan Drive Toronto, Ontario M4H 1E9 Phone: (416) 467-5555 Fax: (416) 467-9824 Email: ats@altech-group.com	
Jensen Precast http://www.jensenprecast.com	Jeff Friedman (916) 992-8317 Toll Free: (800) 843-9569	
Kistner Concrete Products http://www.kistner.com/	Mike Kistner 716-434-6157	Environment 21, LLC develops technology for the Stormwater Treatment market and provides Technical Support to an international network of Precast Concrete Manufacturers of "Structural Stormwater Treatment Systems". Proprietary technology includes sedimentation hydraulics, sediment re-suspension hydraulics, and design storm flow hydraulics.
Rinker Materials www.hydroconduit.com	Gary Fortney 385 Tower Road Napa, CA 94558 707-255-3035 x 224 707-975-7522 mobile gfortney@rinker.com	Wet Vaults
Stormwater Management Inc http://www.stormwatermgt.com/	William Harris Jr. (Sr. Regional Manager) Neil Erickson (Nor. Cal Regional Mngr) California, Hawaii, Nevada 877.446.7250 (p) 909.790.5289 (f) 909.499.7298 © willh@stormwaterinc.com neile@stormwaterinc.com	StormFilter is a Best Management Practice (BMP) filtration system for removing a variety of pollutants. The StormFilter cartridges are filled with an array of media, selected to treat the specific pollutant loadings at each site.

Company Name[2]	Vendor Information/Company Information	Product descriptions
Abtech Industries, Inc	Robert AbTech Industries 4110 North Scottsdale Road, Suite 235 Scottsdale, Arizona 85251 480-874-4000 800-545-8999 Fax: 480-970-1665	The Ultra-Urban Filter® BMP Filter is designed to capture oil and grease, trash and sediment from stormwater runoff before it enters the storm drain system.
Vortechnics Inc	John Stiver, Regional Sales Manager John Rackers 650-323-6110 Phone: 916-984-6085 Fax: 916-984-6086 E-mail: jstiver@vortechnics.com Email: jrackers@contech-cpi.com	The Vortechs System is a reinforced concrete vaulted structure with a swirl chamber, baffle wall and flow control wall. Designed to slow the water down, and give pollutants an opportunity to settle out in the swirl chamber or rise to the surface, all without washout during the peak events. Designed for 80% TSS removal on a net annual basis of extremely fine particles, realistic to typical urban roadway runoff.The VortSentry System is a product designed on the same principals as the Vortechs System, except in a small footprint manhole type configuration.
Invisible Structures, Inc	Andy Gersen Matzke Company 2626 Greenway Ave. Longview, WA 98632 206-595-2203 Andy@isomedia.com	
Bay Area Concretes, Inc	Mike Price P.O. Box 599 Madera, CA 510-651-6020	Porous Pavers
Westcon Pavers www.westconpavers.com	Elaine Hart 1821 Mayes Road SE Olympia, WA 866-816-2111	Porous Pavers
Pavestone, Co. www.pavestone.com	Mark Ketchum 27600 Country Road 90 Winters, CA 95694 530-795-4400 p 530-517-1242 m 530-795-4441 f mark.ketchum@pavestone.com	Porous Pavers

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

ATTACHMENT III-5

Landscape Maintenance Techniques For Pest Reduction

PROPERTY MAINTENANCE FACT SHEET

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Landscape Maintenance Techniques for Pest Reduction

Who should use this Fact Sheet?

- Development Project Applicants
- City/County Planners
- Landscape Maintenance Personnel
- Landscape Architects
- Homeowners

Why is it Important to Reduce Pesticide Usage?

When it rains, pesticides used in maintaining landscapes and gardens are washed off the plants and soils they are used to protect. This stormwater runs off the landscape and flows to the nearest storm drain, which ultimately carries the water to a local creek or the San Francisco Bay without treatment. Pesticides carried with stormwater into creeks and the Bay may be harmful to fish and other organisms that live there. Minimizing use of pesticides in landscape maintenance helps protect water quality, aquatic life, and human health.

What is Integrated Pest Management?

Integrated Pest Management (IPM) is a decision-making process for managing pests that uses monitoring to determine pest-caused injury levels and determine the best methods for their control. IPM uses a combination of :

- biological controls (e.g., natural enemies or predators);
- physical or mechanical controls (e.g., hand labor or mowing);
- cultural controls (e.g., mulching, discing, or alternative plant type selection); and
- reduced risk chemical controls (e.g., soaps or oils)

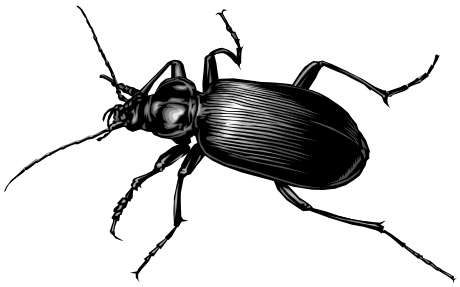
in order to minimize pesticide usage. The IPM method uses the least hazardous pesticides only as a last resort for controlling pests.

How Can Landscape Design and Maintenance Techniques Reduce Pesticide Usage?

Pesticides are often used in maintaining landscapes. The amount of pesticides entering our creeks and Bay can be decreased by using alternative design and maintenance techniques that:

- Reduce the potential for the pesticides to run off the landscape;
- Reduce the amount of chemicals necessary to ensure healthy plants or eliminate the need for pesticide usage at all; or,
- Decrease the need for landscape maintenance by designing landscapes that minimize pest infestation and create low maintenance environments.

Refer to the back of this fact sheet for more design and maintenance tips.



Pest Reducing Landscape Design Techniques

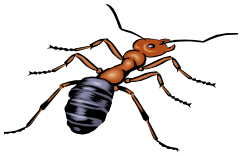
- Design the landscape for efficient irrigation and drainage.
- Design the landscape to conform to natural drainage patterns.
- Retain existing native, pest-resistant trees, shrubs and plants.
- Select pest-resistant plants adapted to your specific area. Consider site-specific characteristics such as the soil, topography, climate, amount and timing of sunlight, prevailing winds, rainfall, air movement, patterns of land use, ecological consistency and plant interactions.
- Prevent the need for routine pruning by selecting plants based on their size and shape when mature.
- Situate plants to facilitate maintenance. Install mowing strips, tree wells and pathway edging to reduce problems associated with maintaining the interface between different elements of the design.
- Plant at the right time of year.

Pest Reducing Landscape Maintenance Techniques

- Employ nonchemical Integrated Pest Management methods (biological, physical and cultural controls) before using chemicals to treat a pest problem.
- If pesticides are necessary, use the least toxic pesticide available. Avoid use of organophosphates such as diazinon and chlorpyrifos (Dursban) as well as copper-based pesticides.
- Do not over apply pesticide. Spray only where the infestation exists. Follow the manufacturer's instructions for mixing and applying materials.
- Properly sweep up spilled fertilizers or pesticides. Do not wash away or bury such spills.
- Properly dispose of chemical wastes by recycling, reusing, or disposing of as hazardous waste. Do not dispose of debris into or near channels or other waterways or leave it where it may contact runoff.
- Apply pesticides at the appropriate time to maximize their effectiveness and minimize the likelihood of discharging undegraded pesticides into runoff. With the exception of pre-emergent pesticides, avoid application if rain is expected.
- Maintain healthy soils by incorporating organic matter, making regular pH adjustments, and appropriately fertilizing.
- Do not overwater.
- Minimize irrigation overspray.
- Prune to increase air circulation but do not overprune.
- Apply 2-4 inches of mulch or geotextiles to exposed soils to prevent weed growth.
- Mow lawns and turf high and leave clippings in place.
- Replace problem plants with locally-adapted, pest resistant plants.
- Remove, rake up and dispose of diseased plant parts.

ADDITIONAL RESOURCES

IPM Access, www.efn.org/~ipmpa, *IPM Based Landscape Design.*



Bio-Integral Resource Center (BIRC) (510) 524-2567
www.birc.org

Central Contra Costa County Sanitary District
Our Water Our World IPM Fact Sheets
www.centralsan.org

San Francisco Department of the Environment
www.sfenvironment.com

IPM Information: www.watershedwatch.net

University of California Cooperative Extension Master Gardeners: www.mastergardeners.org

University of California IPM (800) 994-8849
www.ipm.ucdavis.edu

- Natural Enemies Handbook: The Illustrated Guide to Biological Pest Control
- The UC Guide to Solving Garden and Landscape Problems: An Interactive CD- ROM
- Pests of Landscape Trees and Shrubs